

Historic, Archive Document

Do not assume content reflects current scientific knowledge, policies, or practices.

serve

United States Department of Agriculture
Agricultural Research Administration
Bureau of Animal Industry

THE VITAMIN CONTENT OF ANIMAL FEEDSTUFFS

By N. R. Ellis, Senior Chemist, and L. L. Madsen, Nutritionist
Animal Husbandry Division

LIBRARY
CURRENT SERIAL RECORD

JUN 8 - 1944

U.S. DEPARTMENT OF AGRICULTURE

The summarization of the vitamin content of feedstuffs, presented in the tables which follow, is designed to bring together available quantitative information, which has been reported in the literature or is otherwise available in this Division, for the use of nutrition workers, mixed-feed manufacturers, and feeders. The vitamins covered in the tables include vitamin A together with carotene, thiamin, riboflavin, niacin (nicotinic acid), pantothenic acid, vitamin D, and vitamin E. In all cases the content has been expressed on a pound basis. In the cases of vitamin A and vitamin D the International Unit has been used as the method of expression. In all other instances the actual weight of the vitamin substance is given in milligrams.

The values for carotene given in table 1 are derived from determinations made by a variety of methods some of which are said to yield "pure" carotene and others "crude" carotene values. More carotene determinations with the use of carefully controlled chromatographic procedures are needed particularly for the lower grade dried roughages, for silages, and for grains, especially yellow corn. In this summary it has not seemed advisable to convert milligrams of carotene to International Units of vitamin A or vice versa because of variations in factors and analytical methods employed. It is recognized, of course, that the International Unit is equivalent to 0.6 microgram of pure beta carotene. Properly determined carotene values for green forages and well-cured hay crops which have not been in storage too long appear to be convertible to vitamin A activity fairly satisfactorily by the use of this standard. Unfortunately, comparatively few biological assays for vitamin A, using the International beta carotene preparation as a reference standard, have been made on feedstuffs. Sherman-Munsell vitamin A units, where utilized in the tabulation, have been converted into International Units principally by the use of the factor 1.4. It should be borne in mind that the vitamin A value of feeds of plant origin is entirely dependent on the content of biologically active yellow pigments commonly termed carotenes.

The thiamin values, expressed in milligrams (table 2), can be converted into International Units of vitamin B₁ on the basis of 3 micrograms being equivalent to one International Unit. Nearly all the riboflavin values given in the table are based on direct determinations rather than calculated from Bourquin-Sherman Units. Where used, the number of Bourquin-Sherman Units were multiplied by 2 in converting to the milligram values.

It will be noted in the tables that the data include number of samples and the minimum, maximum, and average quantities of the vitamin in question. Wherever possible, reported values which were questionable or obviously out of line were eliminated in averaging the figures. Arithmetic averages based on numbers of samples were used for the most part although averages based on numbers of laboratories or analytical procedures were calculated in some instances where disproportionate numbers of samples appeared likely to influence unduly the average figure in favor of a particular method. The minimum and maximum are usually the actual extreme values found although some extreme values have been omitted where they appeared to be of questionable significance. Where very few samples of a given feedstuff have been assayed as, for example, for niacin and pantothenic acid and the methods of assay have not been thoroughly standardized, it has been felt best to list the extremes even though they appear unreasonably wide. Subsequent assays may show that some of these extreme values were the result of unsatisfactory technique.

The vitamin A and D potencies of fish oils and the vitamin D potency of various irradiated concentrates or preparations are not reviewed here because these products are usually sold on a standardized basis.

Table 1.--Carotene and vitamin A content of animal feedstuffs

GRAINS, SEEDS, AND MILL CONCENTRATES

Feedstuff	Carotene				Vitamin A			
	Milligrams				International Units			
	per pound				per pound			
	No. : :samples	Mini- :mum	Maxi- :mum	Aver- :age	No. : :samples	Mini- :mum	Maxi- :mum	Aver- :age
Acorns (willow oak)					1			80,000
Barley meal	2	0.05	0.34	0.19				
Corn, yellow	42	.59	4.09	2.20	31	381	4,339	1,990
1 year storage	3	1.78	2.04	1.88				
2 years storage	3	.86	1.73	1.18				
3 years storage	3	1.35	1.60	1.46				
4 years storage	7	1.00	1.28	1.14				
Corn gluten, yellow	5	1.60	18.82	10.19	1			4,000
Cottonseed meal	2	.03	.14	.09	1			5 1/4
Cowpeas, immature, fresh	9	.64	1.05	.85				
Cowpeas, mature	11	.09	.19	.13	10	0		227 1/2
Feterita	1			.14				
Hegari	1			.18	1			163
Hominy, yellow					1			4,512
Hominy feed, yellow					1			806
Kafir	3	.14	.18	.17	3	173	269	218
Linseed meal	3	.10	.13	.12				
Milo grain, yellow	1			.09	6	154	269	250
Milo heads, ground	1			.31				
Oats	29	.01	.14	.05				
Peanuts, kernels					1			118
Rye	4	.02	.05	.04				
Soybeans, immature, fresh	45	.96	3.20	1.97				
Soybeans, mature	65	.09	1.10	.38	13	0	590	178
Soybean meal	1			.10				
Wheat	98	.57	2.40	1.15	3	0	150	86
Wheat bran	13	.05	2.86	1.18				
Wheat germ					1			454
Wheat, gray shorts					2	26	173	99
Wheat middlings	9	1.02	1.94	1.39				

1/ This value represents one sample from each of two varieties (Groit and brown Sugar Crowder); seven other varieties tested had no apparent vitamin A potency.

Table 1.--Carotene and vitamin A content of animal feedstuffs^{2/}--Continued

GREEN FORAGES (fresh and dry basis)

Feedstuff	No. samples	Carotene		
		Milligrams per pound		
		Mini- mum	Maxi- mum	Aver- age
Alfalfa, fresh	35	14.72	40.76	28.30
Alfalfa, dry	60	37.72	196.36	118.03
Barley, fresh	8	16.29	27.22	20.91
Barley, dry	8	77.73	194.80	140.14
Beans, mung, dry	3	44.86	113.32	81.91
Beardgrass, silver, dry	1			119.09
Bermuda grass, dry	25	69.32	215.91	138.52
Bluegrass, Kentucky, fresh	9	4.10	78.20	36.05
Bluegrass, Kentucky, dry	13	18.50	300.90	137.89
Bluegrass, Texas, dry	1			131.36
Bluestem grass, big, fresh	5	1.36	35.00	17.91
Bluestem grass, big, dry	6	1.82	100.45	52.85
Bluestem grass, little, fresh	4	12.30	30.50	20.10
Bluestem grass, little, dry	4	19.70	70.80	45.60
Bromegrass, fresh	24	15.60	48.90	31.55
Bromegrass, dry	28	30.00	261.36	141.99
Buffalo grass, fresh	5	3.00	57.20	27.22
Buffalo grass, dry	15	21.82	128.18	72.06
Bur-clover, fresh	2	28.58	32.21	30.40
Cactus, prickly pear, dry	1			2.73
Cactus, spineless, dry	1			15.00
Carpet grass, dry	1			169.65
Carrot tops, fresh	1			64.10
Clover, crimson, dry	1			194.59
Clover, white, dry	14	65.00	250.91	153.40
Clover, white Dutch, dry	1			209.56
Corn leaves, fresh	9	18.43	80.59	54.79
Corn leaves, dry	9	31.09	293.68	203.68
Corn plant, fresh	9	3.45	13.77	8.58
Corn plant, dry	18	9.55	52.27	27.48
Dallis grass, dry	4	77.59	225.00	143.72
Dandelion leaves, fresh	1			36.50
Dock leaves, fresh	1			59.09
Fingergrass, black, dry	2	54.09	75.00	64.55
Grama grass, black, dry	15	2.45	57.14	19.88
Grama grass, hairy, dry	1			55.45
Grama grass, red, dry	4	29.09	70.45	46.36
Grama grass, Texas, dry	3	30.91	90.45	58.94
Guajillo leaves, dry	1			47.73
Guinea grass, fresh	1			12.74
Guinea grass, dry	1			53.68
Indian grass, dry	1			169.55
Johnson grass, dry	6	31.36	166.36	83.31
June grass, dry	1			71.82
Knotgrass, dry	1			100.00
Meadow fescue, dry	4	129.73	248.12	207.07
Mesa dropseed grass, dry	8	.00	63.00	34.35
Mesquite grass, dry	2			19.25
Mesquite grass, curly, dry	6	50.91	100.91	69.32
Mesquite grass, grapevine, dry	1			61.82
Mesquite leaves, dry	1			20.00
Napiergrass, fresh	1			12.91
Napiergrass, dry	1			48.27
Oak (live and post) leaves, dry	8	25.00	60.45	49.13
Oat plant, fresh	37	2.67	63.50	26.95
Oat plant, dry	39	5.73	423.34	174.53

Continued

Table 1.—Carotene and vitamin A content of animal feedstuffs—Continued

GREEN FORAGES (fresh and dry basis)—Continued

Feedstuff	No. : samples	Carotene		
		Milligrams		
		Mini-	Maxi-	Aver-
		mum	mum	age
Orchard grass, fresh	4	17.20	30.80	26.55
Orchard grass, dry	26	19.09	215.91	98.69
Perennial grass and clover pasture, dry	6	100.00	130.00	118.18
Quackgrass, dry	1			56.25
Redtop, fresh	4	15.30	25.90	19.00
Redtop, dry	4	24.40	109.20	53.93
Rescue grass, dry	1			185.55
Rhodes grass, fresh	1			21.95
Rhodes grass, dry	2	74.32	128.64	101.45
Ryegrass, perennial, dry	17	24.09	144.68	72.57
Ryegrass, perennial and wild white clover, fresh	1			24.58
Ryegrass, perennial and wild white clover, dry	1			222.27
Rye, fresh	4	25.10	46.27	37.81
Rye, dry	5	114.00	307.09	202.68
Sotal bulb, dry	1			.90
Sotal leaves, dry	1			19.09
Sorghum, Atlas, young, dry	2	45.23	74.91	60.07
Sorghum, Atlas, mature, dry	1			34.82
Soybeans, young plants, some beans, fresh	13	12.09	44.31	37.79
Soybeans, young plants, some beans, dry	13	48.59	196.45	124.45
Soybeans, beans developed, leaves yellow, some dropping:				
Fresh	3	3.66	5.54	4.70
Dry	3	9.55	16.09	13.17
Spear grass, dry	1			124.55
Sudan grass, fresh	13	9.43	33.01	21.54
Sudan grass, dry	15	24.32	206.68	97.01
Sweetclover, fresh	9	12.70	18.15	15.04
Sweetclover, dry	10	56.82	110.91	89.42
Switchgrass, dry	3	22.70	36.60	31.57
Timothy, dry	10	50.91	145.45	103.73
Wheat, fresh	7	12.70	29.64	20.22
Wheat, dry	9	81.36	169.68	117.70

2/ Insufficient information available for tabulation of vitamin A content of green forages.

Table 1.—Carotene and vitamin A content of animal feedstuffs--Continued

DRIED FORAGES

Feedstuff	Carotene				Vitamin A			
	Milligrams				International Units			
	per pound				per pound			
	No. : : samples	Mini- : mum	Maxi- : mum	Aver- : age	No. : : samples	Mini- : mum	Maxi- : mum	Aver- : age
Grade: U.S.No.1								
alfalfa	26	8.64	55.00	19.40				
alfalfa clover mixed	1			21.27				
alfalfa heavy grass mixed	2	16.00	26.09	21.04				
clover	6	5.00	19.55	10.99				
clover light timothy mixed	10	5.00	19.55	8.98				
timothy	19	3.64	16.36	9.15				
Grade: U.S.No.2								
alfalfa	12	5.00	21.68	8.96				
alfalfa clover mixed	3	11.59	20.14	17.03				
alfalfa heavy grass mixed	2	9.95	13.91	11.93				
alfalfa light grass mixed	4	5.00	13.00	9.24				
alfalfa heavy timothy								
mixed	1			6.95				
clover	4	3.68	8.91	6.29				
clover light timothy mixed	1			8.18				
grass light clover mixed	1			7.41				
grass light alfalfa mixed	1			14.18				
timothy	3	3.64	5.00	4.24				
timothy light alfalfa								
mixed	1			11.64				
timothy medium clover								
mixed	1			7.50				
timothy heavy grass mixed	4	4.41	10.36	6.94				
timothy light grass mixed	2	5.64	6.23	5.93				
Grade: U.S.No.3								
alfalfa	18	.45	14.73	3.25				
alfalfa heavy brome mixed	1			9.04				
alfalfa heavy grass mixed	3	5.55	13.45	8.27				
clover light timothy								
mixed	1			3.18				
grass light clover mixed	1			10.14				
timothy	29	.45	5.45	2.52				
timothy light alfalfa								
mixed	1			4.45				
timothy heavy grass								
mixed	1			3.59				
U.S. hays and meals								
Ungraded								
alfalfa hay:								
Dehydrated	26	4.63	113.83	54.60	6	38,102	95,200	59,657
Sun-cured (all analyses)	67	.45	55.00	11.36	41	1,361	48,263	13,925
Cured in shade					11	5,715	48,263	23,843
Exposed to rain					13	4,128	20,321	9,391
alfalfa leaf meal:								
Dehydrated	218	9.16	184.73	62.77	13	36,250	82,192	59,167
Dehydrated								
22 percent protein and over	46	22.27	177.27	94.86				
20 ± 1 percent protein	71	18.60	129.55	74.05				
17 ± 1 percent protein	99	10.45	110.00	53.36				
15 to 16 percent protein	31	12.70	92.27	48.27				
13 ± 1 percent protein	51	4.55	90.00	29.70				
Below 12 percent protein	7	3.64	40.90	19.00				
Sun-cured	39	10.45	54.89	30.03	6	3,802	43,763	15,184

Continued

Table 1.—Carotene and vitamin A content of animal feedstuffs—Continued

DRIED FORAGES—Continued

Feedstuff	Carotene				Vitamin A			
	Milligrams				International Units			
	No.	per pound			No.	per pound		
	: samples	: Mini-	: Maxi-	: Aver-	: samples	: Mini-	: Maxi-	: Aver-
		: mum	: mum	: age		: mum	: mum	: age
Miscellaneous hay and meals								
Ungraded (continued):								
Alfalfa meal:								
Dehydrated	127	4.23	145.32	44.56				
Sun-cured	99	3.64	71.36	16.63				
Alfalfa-stem meal	5	2.27	12.40	4.30				
Beans, mung	14	2.41	70.14	30.41				
Bermuda grass hay	31	.91	67.05	20.62				
Bluestem grass hay, big	2	4.36	8.00	6.18				
Bluestem grass hay, little	2	5.77	9.45	7.61				
Clover, wild white and perennial rye mixed hay:								
Sun-cured	2	55.45	70.00	62.73				
Dehydrated	3	173.64	198.64	188.18				
Corn fodder	2	.91	2.73	1.82				
Feather sage	3	7.18	7.41	7.32				
Hegari fodder	3	1.00	3.86	1.98				
Hegari stover					1			1,780
Johnson grass hay	11	1.91	28.41	12.87	1			5,440
Kudzu	3	11.85	26.40	17.83				
Lespedeza, Korean	14	4.14	41.59	22.41				
Lespedeza, sericea	3	5.36	23.67	15.94				
Milo fodder	2			.91				
Oats, dehydrated	13	19.10	185.07	104.09				
Peanut hay	12	2.40	20.41	7.97	5	4,355	20,668	11,213
Pea-vine meal	2	28.12	31.24	29.68				
Perennial grass and clover hay	12	3.64	8.64	6.74				
Prairie hay	28	1.11	26.13	11.49				
Rhodes grass hay	1			.91				
Ryegrass	6	11.27	37.23	25.52				
Sorghum (sunac) fodder	15	.36	2.27	1.22				
Soybean hay:								
Young, pods starting, field-cured					1			22,680
Young, pods starting, dehydrated					1			34,470
Late cut, beans formed, field-cured					1			4,990
Late-cut, beans formed, dehydrated					1			19,051
Sudan grass hay	3	1.82	4.09	2.88				
Switchgrass hay	9	2.27	21.73	12.21				
Timothy, dehydrated	1			20.41	1			139,709
Wheat	8	13.14	57.32	44.12				
Wheatgrass, crested	1			20.91				
Wheatgrass, western	1			14.43				

Table 1.—Carotene and vitamin A content of animal feedstuffs --Continued

DRIED AND DORMANT RANGE GRASSES^{3/} (Dry basis)

Feedstuff	Carotene			
	No. : samples	Milligrams per pound		
		Mini- : mum	Maxi- mum	Aver- age
Beardgrass, silver	2	3.63	6.36	5.00
Bermuda grass	1			0.91
Buffalo grass	12	1.82	42.73	12.05
Crowfoot grass	6	2.05	20.00	8.26
Dallis grass	1			6.82
Fingergrass, black	5	4.14	10.00	7.10
Georgia grass	3	.36	5.90	3.49
Grama grass, hairy	5	2.04	8.18	4.53
Grama grass, sideoats	1			4.55
Grama grass, Texas	3	10.50	22.73	15.01
Mesquite grass, curly	6	2.73	33.20	16.08
Needlegrass	2	4.09	5.91	5.00
Prairie grass	1			11.36
Sage grass	1			2.86
Sandhill grass	2	1.00	2.73	1.87
Tabosa grass	2	3.55	5.91	4.73

SILAGES^{5/}

Alfalfa, moist	9	4.94	22.99	14.89
Alfalfa, dry	9	15.98	94.41	54.72
Alfalfa, half-dried, moist	4	9.07	16.62	11.63
Alfalfa, half-dried, dry	4	14.64	22.50	18.01
Alfalfa, wilted, moist	7	5.74	23.24	13.14
Alfalfa, wilted, dry	7	14.32	56.86	33.59
Alfalfa, A.I.V., moist ^{4/}	15	9.07	29.14	20.72
Alfalfa, A.I.V., dry ^{4/}	15	35.45	116.36	80.97
Alfalfa (hydrochloric and sulfuric acids):				
Moist	8	17.78	23.85	21.17
Dry	8	50.91	99.18	74.73
Alfalfa (molasses), moist	8	7.41	20.67	15.40
Alfalfa (molasses), dry	8	28.09	77.27	58.05
Alfalfa (phosphoric acid), moist	4	6.46	19.46	12.94
Alfalfa (phosphoric acid), dry	4	25.09	69.14	48.05
Alfalfa (salt), moist	9	9.57	18.16	15.15
Alfalfa (salt), dry	9	31.75	71.82	52.24
Alfalfa (85% green and 15% dry), moist	1			14.97
Alfalfa (85% green and 15% dry), dry	1			43.90

Continued

^{3/} Collected during the summer and winter months on Texas range.

Table 1.—Carotene and vitamin A content of animal feedstuffs--Continued

SILAGES 5/—Continued

Feedstuff	Carotene				Vitamin A			
	: Milligrams				: International Units			
	: per pound				: per pound			
	No. : samples	Mini- : mum	Maxi- : mum	Aver- : age	No. : samples	Mini- : mum	Maxi- : mum	Aver- : age
Alfalfa and brome-								
grass (phosphoric								
acid), moist	3	14.09	21.59	18.03				
Alfalfa, 87½%, and								
corn and cob meal,								
12½%:								
Moist	1			15.53				
Dry	1			47.14				
Alfalfa and mixed grass								
(molasses):								
Moist	1			11.79				
Dry	1			35.13				
Alfalfa, 85%, and dry								
timothy, 15%:								
Moist	1			9.74				
Dry	1			60.32				
Beans, mung, dry	1			38.09				
Bluegrass, Kentucky, moist	1			37.34				
Bluegrass, Kentucky, dry	1			111.36				
Bluegrass, Kentucky,								
partially dried:								
Moist	1			52.58				
Dry	1			66.36				
Bluegrass, Kentucky,								
(hydrochloric and								
sulfuric acids):								
Moist	1			39.08				
Dry	1			113.18				
Bluegrass, Kentucky								
(3% molasses, 3% water):								
Moist	1			42.18				
Dry	1			114.55				
Bromegrass, moist	1			12.25				
Bromegrass (phosphoric								
acid), moist	1			23.81				
Corn, moist	44	0.45	18.18	5.99	5	1,587	25,347	15,406
Corn, dry	76	1.82	70.91	22.59				
Corn (molasses), moist	3	5.35	7.21	5.71	1			19,183
Grass, mixed, dry	3	39.95	102.27	79.83				
Grass (molasses), moist	2	10.48	11.66	11.07	1			30,659
Lespedeza sericea								
(molasses):								
Moist	1			24.71				
Dry	1			63.00				
Lespedeza sericea								
(phosphoric acid):								
Moist	1			25.70				
Dry	1			63.91				

Continued

Table 1.--Carotene and vitamin A content of animal feedstuffs--Continued

SILAGES 5/--Continued

Feedstuff	Carotene				Vitamin A			
	: Milligrams				: International Units			
	: per pound				: per pound			
	No. : samples:	Mini-	Maxi-	Aver-	No. : samples:	Mini-	Maxi-	Aver-
		:mum	mum	age		:mum	mum	age
:								
:								
:								
:								
Lespedeza sericea								
and about 10% grass,								
mostly redtop:								
Moist	1			21.78				
Dry	1			65.27				
:								
:								
:								
:								
Lespedeza sericea								
and about 10% grass,								
mostly redtop (2 1/2 -								
5% molasses):								
Moist	2	20.51	23.63	22.07				
Dry	2	60.14	69.45	64.80				
:								
:								
:								
:								
Lespedeza sericea								
and about 10% grass,								
mostly redtop, half-								
dried:								
Moist	1			21.17				
Dry	1			36.63				
:								
:								
:								
:								
Lespedeza sericea								
and about 10% grass,								
mostly redtop, half-								
dried, (2 1/2 - 5%								
molasses):								
Moist	2	29.49	30.19	29.84				
Dry	2	53.14	54.00	53.57				
Oatgrass, dry	2	189.15	206.84	198.00				
Oats, moist	1			17.70				
Oats, dry	1			66.82				
Oats (molasses), moist	1			3.67	1			10,918
Oats, wilted, moist	2	7.89	12.02	9.96				
Oats, wilted, dry	2	21.68	31.14	26.41				
:								
:								
:								
:								
Oats, wilted (molasses):								
Moist	2	13.55	17.94	31.96				
Dry	2	38.09	58.09	48.09				
Oats and peas, dry	2	93.18	118.18	105.68				
Oats and peas, wilted, dry	2	49.50	70.91	60.21				
:								
:								
:								
:								
Orchard grass, early-cut								
prebloom:								
Moist	2	24.62	27.96	26.29				
Dry	2	91.45	99.09	95.27				
:								
:								
:								
:								
Orchard grass, late-cut								
full-bloom:								
Moist	1			15.86				
Dry	1			61.50				
:								
:								
:								
:								
Orchard grass, wilted:								
Moist	4	18.14	31.35	24.00				
Dry	4	55.09	91.45	71.70				
:								
:								
:								
:								
Orchard grass, late-cut								
full-bloom, wilted:								
Moist	1			15.44				
Dry	1			39.55				
:								
:								
:								
:								
Orchard grass, early-cut								
prebloom (molasses):								
Moist	1			23.21				
Dry	1			87.68				
:								

Continued

Table 1.—Carotene and vitamin A content of animal feedstuffs—Continued

SILAGES 5/--Continued

Feedstuff	Carotene					Vitamin A				
	: Milligrams					: International Units				
	: per pound					: per pound				
	No. : : samples	Mini- : mum	Maxi- : mum	Aver- : age		No. : : samples	Mini- : mum	Maxi- : mum	Aver- : age	
Orchard grass, late- cut full-bloom (molasses):										
Moist	1			15.35	:					
Dry	1			57.91	:					
Orchard grass and alfalfa, both prebloom:										
Moist	1			26.59	:					
Dry	1			103.73	:					
Orchard grass, full- bloom, and alfalfa early-bloom:										
Moist	1			27.36	:					
Dry	1			99.77	:					
Orchard grass and alfalfa, both prebloom, wilted:										
Moist	1			18.80	:					
Dry	1			61.82	:					
Orchard grass, full- bloom, and alfalfa, early-bloom, wilted:										
Moist	1			31.35	:					
Dry	1			78.45	:					
Orchard grass and alfalfa, both pre- bloom (molasses):										
Moist	1			26.17	:					
Dry	1			98.50	:					
Orchard grass, full-bloom, and alfalfa, early- bloom (molasses):										
Moist	1			24.12	:					
Dry	1			83.68	:					
Orchard grass, white clover and lespedeza:										
Moist	1			34.40	:					
Dry	1			121.80	:					
Orchard grass, white clover and lespedeza, partially dried:										
Moist	1			44.14	:					
Dry	1			90.45	:					
Orchard grass, white clover and lespedeza (hydrochloric and sulfuric acids)										
Moist	1			36.54	:					
Dry	1			133.64	:					
Perennial grass and clover, dry	8	48.64	130.91	93.01	:					
Rye and vetch, moist	1			18.14	:					
Rye and vetch, dry	1			61.59	:					
Rye and vetch(molasses):										
Moist	1			15.68	:					
Dry	1			84.82	:					

Continued

Table 1.—Carotene and vitamin A content of animal feedstuffs—Continued

SILAGES 5/—Continued

Feedstuff	Carotene				Vitamin A			
	: Milligrams				: International Units			
	: No. : per pound				: No. : per pound			
	: samples:	Mini-	Maxi-	Aver-	: samples:	Mini-	Maxi-	Aver-
	: :mum	mum	mum	age	: :mum	mum	mum	age
Sorghum, kafir, moist ,	15	0.23	5.49	1.44	:			
Sorghum, kafir, dry	15	.64	15.68	4.24	:			
Sorghum, sumac, moist	27	.23	5.93	2.70	:	2	2,995	5,434
Sorghum, sumac, dry	27	.91	23.18	10.57	:			4,215
Soybean, moist	8	8.84	19.73	14.59	:			
Soybean, dry	8	30.45	92.73	56.68	:			
Soybean (A.I.V.), moist 4/	2			13.38	:			
Soybean (A.I.V.), dry 4/	2			79.00	:	1		36,288
Soybean (Hydrochloric					:			
and sulfuric acids:					:			
Moist	4	13.27	17.84	15.48	:			
Dry	4	45.09	61.82	53.20	:			
Soybean (molasses), moist	6	2.99	19.00	9.69	:			
Soybean (molasses), dry	4	28.36	67.27	55.95	:			
Soybean (phosphoric acid):					:			
Moist	1			15.16	:			
Dry	1			50.95	:			
Soybean (.25-1.25% salt):					:			
Moist	6	14.90	19.35	17.23	:			
Dry	6	67.09	87.27	77.09	:			
Soybean, 87 1/2%, and					:			
alfalfa hay 12 1/2%:					:			
Moist	1			12.28	:			
Dry	1			42.45	:			
Soybean, 87 1/2%, and corn					:			
and cob meal, 12 1/2%:					:			
Moist	1			11.72	:			
Dry	1			40.60	:			
Soybean, 87 1/2%, and					:			
timothy hay, 12 1/2%:					:			
Moist	1			12.93	:			
Dry	1			44.55	:			
Sweetclover, moist	3	2.27	4.41	2.98	:			
Timothy (molasses 50#/ton):					:			
Moist	2	9.07	17.24	13.16	:			
Dry	2	28.58	83.92	56.25	:			

4/ A method developed by A. I. Virtanen of Finland for making silage from hay crops by adding dilute mineral acid to the forage.

5/ Preserving materials added to the forage as ensiled are indicated in parenthesis.

Table 2.--Thiamin, riboflavin, niacin, and pantothenic acid content in animal feedstuffs expressed as milligrams per pound

GRAINS, SEEDS, AND MILL CONCENTRATES

Feedstuff	Thiamin (Vitamin B ₁)				Riboflavin (Vitamin G)				Niacin (Nicotinic acid)				Pantothenic acid			
	No. samples	Mini- mum	Maxi- mum	Aver- age	No. samples	Mini- mum	Maxi- mum	Aver- age	No. samples	Mini- mum	Maxi- mum	Aver- age	No. samples	Mini- mum	Maxi- mum	Aver- age
Barley	59	.33	4.18	2.71	16	.23	1.36	.55	15	6.92	44.45	30.44	14	1.79	4.68	2.84
Beans, Navy	15	.70	3.95	2.14	2			1.40	2			12.70	1			.64
Beans, mung	3	1.27	2.27	1.82					1			10.45				
Beans, pinto	1			7.15	1			3.63								
Brewers' dried grains																
Buckwheat	6	1.78	3.85	2.56	3	.18	.36	.26	1			20.00				
Corn, white	28	1.06	3.36	2.22	17	.42	1.04	.61	10	4.50	7.25	6.04				
Corn, yellow	41	1.06	3.58	2.06	32	.38	.92	.60	27	3.18	9.53	6.40	9	2.72	4.54	3.36
Corn bran	1			2.00	1			.70								
Corn distillers' dried grains	1			.70	4	.27	1.50	.66								
Corn distillers' dried grains with solubles	3	1.36	2.71	2.11	3	4.53	7.26	5.90								
Corn distillers' dried solubles	8	2.72	4.54	3.68	8	6.81	15.88	10.22	2			45.00	2			12.00
Corn germ	3	6.26	15.00	9.90	2	.90	2.27	1.59	1			13.70				
Corn-gluten feed												47.20				
Corn-gluten meal	1			4.30	2	0	.77	.39	1			13.60	3	5.13	8.17	6.26
Corn-oil meal	7	4.08	7.08	6.13	1	3.31	6.24	2.95				20.40				6.35
Cottonseed meal	12	2.31	5.04	4.10	9			4.08	3	18.60	22.70	10.80	2			8.00
Cowpeas	5	.23	.45	.34	2	.14	.23	1.25	1			4.08	1			3.00
Hempseed meal	6	4.48	7.34	5.84	3	2.27	3.00	2.75	2	19.53	24.97	22.25	1			3.20

Continued

Table 2.--Thiamin, riboflavin, niacin, and pantothenic acid content in animal feedstuffs expressed as milligrams per pound--Cont'd.

GRAINS, SEEDS, AND MILL CONCENTRATES--Continued

Feedstuff	Thiamin (Vitamin B ₁)			Riboflavin (Vitamin G)			Niacin (Nicotinic acid)			Pantothenic acid		
	No. samples	Mini- mum	Maxi- mum	Aver- age	No. samples	Mini- mum	Maxi- mum	Aver- age	No. samples	Mini- mum	Maxi- mum	Aver- age
Malt sprouts												
Millet	3	2.72	3.72	3.26	1			4.75	1			25.40
Molasses, beet								0	6	6.35	14.05	10.57
Molasses, cane	3	.38	.54	.44	1				2	21.33	22.68	22.00
Oats	28	2.06	4.91	3.43	6	.51	1.27	.97	2	19.95	22.68	21.32
Oat meal(rolled oats)	24	.84	4.43	2.16	10	.10	1.00	.58	8	3.42	9.10	6.50
Palm-kernel meal												
Peanuts, kernels	48	1.35	5.76	3.75	3	.23	.64	.45	6	2.59	11.35	7.57
Peanut meal	6	2.72	3.67	3.27	4	.75	2.10	1.75	1	40.40	123.00	19.95
Peas, chick	1			.75	25	1.22	3.36	2.35	6	58.90	99.80	60.50
Peas, field,ripe	1			3.60	6			.40	1			17.65
Rice, Brewers'	7	.54	.76	.64								
Rice, brown	14	.41	1.59	1.10	4			.32	4	3.63	31.30	17.13
Rice, polished	10	.14	.34	.26	2			.36	7	2.09	14.10	8.08
Rice, rough	19	.45	1.63	1.16	1			.55	3	5.04	22.70	13.80
Rice bran	18	5.36	17.02	10.32	3	1.09	1.81	1.38	2			129.10
Rice germ									4	6.81	12.25	10.33
Rice hulls	7	.38	.61	.50								
Rice polish	18	1.70	13.63	8.84	3	.70	1.36	.92	2	212.20	438.00	325.00
Rice screenings	7	.30	.41	.36								
Rye	18	1.36	2.59	2.00	9	.68	1.09	.71	9	4.40	28.50	8.22
Rye germ	3	4.08	9.95	6.10	3	2.02	4.54	3.69	1			12.22
Rye middlings	2			1.50	2			1.02	2			7.80
Sesame meal												
Sorghum, grain	11	1.08	3.97	2.37	2	1.23	1.73	1.48	3	18.15	39.00	29.35
Sorgo, seeds	1			1.59	2	.45	.73	.60	5	6.35	9.98	8.17
Soybeans	16	4.35	6.53	5.14	7	.75	1.46	1.21	7	5.44	22.00	15.87
Soybean meal	5	1.36	5.31	2.62	10	1.36	3.86	1.87	5	16.33	18.15	17.60
Sunflower seeds	1			.23								

Continued

Table 2.--Thiamin, riboflavin, niacin, and pantothenic acid content in animal feedstuffs expressed as milligrams per pound--Cont'd.

GRAINS, SEEDS, AND MILL CONCENTRATES--Continued

Feedstuff	Thiamin (Vitamin B ₁)			Riboflavin (Vitamin G)			Niacin (Nicotinic acid)			Pantothenic acid		
	No. samples	Mini-mum	Maxi-mum	Aver-age	No. samples	Mini-mum	Maxi-mum	Aver-age	No. samples	Mini-mum	Maxi-mum	Aver-age
Wheat	147	1.10	4.62	2.10	136	.36	1.00	.51	81	17.92	48.10	26.74
Wheat, hard	459	1.45	4.62	2.30	15	.40	.87	.53	42	17.92	48.10	28.85
Wheat, soft	77	1.10	3.63	2.20	34	.37	.67	.51	13	23.60	30.40	26.80
Wheat bran	11	1.77	4.90	3.24	11	.45	1.82	1.34	9	109.80	185.60	139.97
Wheat distillers' dried grains					1			2.00				
Wheat germ	14	4.77	16.80	11.40	8	1.81	3.63	2.32	21	13.38	41.30	23.75
Wheat flour middlings	1			6.00	2	.59	.91	.75	2	41.75	46.70	44.20
Wheat standard middlings	2			7.00	2	.57	.91	.74	5	27.66	62.60	52.80
Wheat red dog	12	4.58	11.23	9.88	2	.45	1.73	1.10	4	10.22	54.40	25.00
Wheat shorts	12	4.63	10.50	7.84	2			1.28	4	38.30	46.70	43.00
Yeast, brewers', dried	25	13.60	75.00	31.20	16	8.16	56.40	20.27	16	153.70	283.50	216.70

ANIMAL, MARINE, AND MILK PRODUCTS

Blood meal	1			.18	1			1.40	1			12.25	1		.45
Buttermilk	2	1.15	1.35	1.24	19	14.30	19.85	.71	2	.59	.61	.60	4	1.59	2.09
Buttermilk, dried					2	1.32	2.50	1.90	2	5.90	9.53	7.72	5	15.51	19.80
Crab meal					9	.45	3.63	2.13							
Fish meal, Menhaden					9	2.09	7.26	4.81							
Fish meal, miscellaneous					4	2.27	4.08	3.17							
Fish meal, sardine	1			.40	21	1.36	7.70	4.00	2	31.30	40.85	36.00		2.36	7.03
Fish meal, whitefish	6	.83	2.18	1.49	4	12.92	19.95	16.78	9	42.15	123.70	75.70			4.22
Liver, beef	1			5.45	6	29.50	61.20	46.54	4			442.30			1.27
Liver, beef, dried	2	1.22	1.77	1.50	3	12.32	12.36	12.33	3	54.00	125.00	88.00			
Liver, pork				7.00	5	38.55	45.36	42.80	2			453.60	1		70.00
Liver, pork, dried	2														

Continued

ANIMAL, MARINE, AND MILK PRODUCTS--Continued

[illegible]

FORAGES, PASTURES, HAYS, SILAGES, ETC.

[illegible]

Continued

Table 2.--Thiamin, riboflavin, niacin, and pantothenic acid content in animal feedstuffs expressed as milligrams per pound--Cont'd.

VEGETABLES, FRUITS AND BYPRODUCTS

Feedstuff	Thiamin (Vitamin B ₁)				Riboflavin (Vitamin G)				Niacin (Nicotinic acid)				Pantothenic acid			
	No. samples	Mini- mum	Maxi- mum	Aver- age	No. samples	Mini- mum	Maxi- mum	Aver- age	No. samples	Mini- mum	Maxi- mum	Aver- age	No. samples	Mini- mum	Maxi- mum	Aver- age
Apples	5	.10	.85	.21	4	.04	.14	.09	1			2.50				
Artichokes	2			.37									1			1.80
Bananas	7	.15	.75	.35	6	.10	.38	.22	1			2.75				
Beet pulp									1			11.80	1			.82
Cabbage	6	.27	.38	.33	10	.14	.36	.23	1			1.32				
Carrots	7	.25	.50	.30	3			.31	1			6.68	1			.90
Chestnuts	2	.75	1.23	1.00												
Kale	1			.75	1			2.20					1			
Potatoes	10	.41	.85	.66	8	.04	.27	.14	1			5.00	2			2.50
Pumpkins	2			.14	2	.09	.27	.18	1			3.18				2.90
Rutabagas	1			.35												
Sweetpotatoes	3			.42	7	.18	1.00	.40	2			6.10	2			5.00
Tomato pomace, dried	1			5.45	1			2.75								
Turnips	8	.27	.54	.40	2			.18								1.50

Table 3.--Vitamin D content in animal feedstuffs expressed as International Units per pound

Feedstuff	No. samples	Minimum	Maximum	Average
Alfalfa hay, dehydrated	2	150	300	225
Alfalfa hay, sun-cured	5	136	2,770	750
Beet pulp	2	0	40	20
Blood meal	1			275
Cacao shell, sun-dried	1			13,150
Corn silage	1			40
Liver, beef, fresh	1			213
Liver, pork, fresh	1			200
Meadow hay (mixed)	1			27
Milk, skim, dried	2			190
Milk, whole, liquid	26	1.2	17.5	6.8
Prairie hay	1			250
Ryegrass, dried	1			32

Table 4.--Vitamin E content in animal feedstuffs expressed as milligrams of alpha-tocopherol per pound

Feedstuff	No. samples	Minimum	Maximum	Average
Alfalfa, fresh	1			69.00
Alfalfa, laboratory-dried	1			47.20
Alfalfa hay, sun-cured	1			11.80
Alfalfa-leaf meal	1			173.80
Bluegrass, Kentucky, fresh	1			70.80
Bluegrass, Kentucky, dried	2	10.75	161.20	157.00
Clover, white, fresh	1			45.36
Clover, white, dried	1			31.77
Corn, white	3	6.81	13.62	11.21
Corn, yellow	3	11.80	16.34	13.93
Oats	2			22.70
Orchard grass, fresh	1			49.45
Orchard grass, dried	1			101.20
Soybeans	5	12.25	20.46	16.61
Soybean forage, fresh	1			31.77
Soybean hay	3	10.16	15.25	12.12
Timothy hay (mixed), No.2	1			5.90
Wheat	9	10.44	24.50	16.88
Wheat bran	1			1.36
Wheat germ	1			72.00
Wheat germ oil	15	478.00	1179.00	962.00
Wheat red dog	1			26.20
Wheat shorts	1			14.42